LAWRENCE LIVERMORE
REPORT

A weekly collection of scientific and technological achievements from Lawrence Livermore National Laboratory, July 5-9, 2010

LLNL garners six R&D 100 awards

The Lab has developed a system to provide non-invasive, ultrahigh resolution, three-dimensional images to view the retinal structures at the cellular level.

The Laboratory has captured six R&D 100 awards this year. Also known as the “Oscars of invention,” the awards are given each year for the development of cutting-edge scientific and engineering technologies with commercial potential.

This year’s awards hike the Lab’s total to 135 since 1978.

The winning technologies are:

- **Statistical Radiation Detection System:** The statistical radiation detection system is a novel software solution that nonexperts can use to rapidly and reliably detect radionuclides in applications that require accurate identification of radioactive material
- **High-Performance Strontium Iodide Scintillator for Gamma-Ray Spectroscopy:** The europium-doped strontium iodide scintillator allows the fastest, highest-resolution gamma-ray spectroscopy for detectors to identify radionuclides for homeland security and other applications.

- **Energy Monitor for Ultrahigh-brightness X-ray Pulses:** The X-ray free electron laser energy monitor non-intrusively measures the energy of ultrahigh intensity X-ray pulses produced by revolutionary X-ray free electron lasers.
- **Grating Actuated Transient Optical Recorder (GATOR):** This technology is a diagnostic system that can acquire sequential images of X-rays or optical light with the time resolution of a trillionth of a second or better.
- **Ultrapermeable Carbon Nanotube Membranes:** Extremely permeable and extremely stable carbon nanotube membranes provide ultrafast water flow that could revolutionize the water purification industry.
- **Microelectromechanical Systems (MEMS)-based Adaptive-Optics Optical Coherence Tomography**: This system is a clinical instrument that provides non-invasive, ultrahigh resolution, three-dimensional volumetric retinal images for ophthalmologists and optometrists to view retinal structures at the cellular level.

  To read more, go to https://publicaffairs.llnl.gov/news/news_releases/2010/NR-10-07-02.html

Material behavior insight comes as a nanoshock

The diamond anvil cell is small enough to fit in the palm of one's hand, but it can compress a sample to extreme pressures — up to about 3.6 million atmospheres at room temperature.

At first, nanoshocks may seem like something to describe the millions of aftershocks of a large earthquake.

But Laboratory physicists are using an ultra-fast laser-based technique they've dubbed "nanoshocks" for something entirely different. In fact, the "nanoshocks" have such a

small spatial scale that the scientists can use them to study shock behavior in tiny samples such as thin films or other systems with microscopic dimensions (a few tens of micrometers). In particular, they have used the technique to shock materials under high static pressure in a diamond anvil cell (DAC).

Using a DAC — which probes the behavior of materials under ultra-high pressures (and which requires small samples) — the team statically compressed a sample of argon up to 78,000 atmospheres of pressure and then further shock-compressed it up a total of 280,000 atmospheres. They analyzed the propagating shock waves using an ultra-fast interferometric technique. Using this technique, they were able to achieve combinations of pressures, temperatures and time scales that are otherwise inaccessible.

For more, go to http://www.sciencedaily.com/releases/2010/07/100706150618.htm

Unearthing an ubiquitous element

The gas giants of our solar system: From left, Jupiter, Saturn, Uranus and Neptune.

Using quantum simulations, scientists at Lawrence Livermore, the University of Illinois at Urbana-Champaign and the University of L'Aquia in Italy have uncovered phase transitions in the laboratory of the most abundant element in the universe., hydrogen

The technique is similar to how hydrogen's phase transitions would occur in the centers of giant planets.

The team discovered a first order phase transition, a discontinuity, in liquid hydrogen between a molecular state with low conductivity and a highly conductive atomic state.

The critical point of the transition occurs at high temperatures, near 3100 degrees Fahrenheit and more than 1 million atmospheres of pressure.

The research sheds light on the properties of this ubiquitous element and may aid in efforts to understand the formation of planets.

To read more, go to http://www.nanotech-now.com/news.cgi?story_id=39033

VERI-fying what's in cargo containers

A VeriTainer Corp. employee is shown at a port where the crane is in operation.

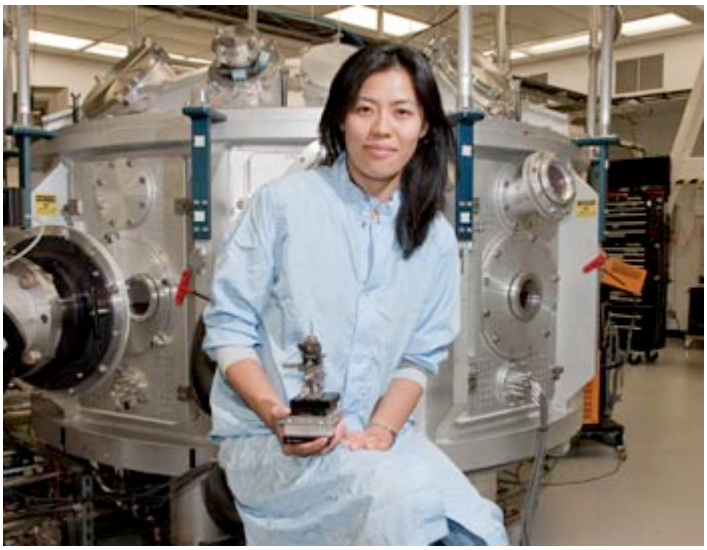
The Lab has signed an agreement with VeriTainer Corporation to refine and enhance the company's crane-mounted scanning technology.

The agreement will be in place for three-and-a-half years and require approximately $4 million in funding. LLNL will work in cooperation with VeriTainer's scientists and engineers to enhance both gamma and neutron detection sensitivity, while maintaining the capabilities of VeriTainer's CMS. The system has been operated for the past four years in field tests run at three ports and in five different terminals.

The Laboratory will use its expertise not only to optimize the sensitivity of the system, but also to leverage the platform to deliver an effective counterterrorism system.

To read more, go to http://www.joc.com/press-release/llnl-and-veritainer-corp-sign-cooperative-research-and-development-agreement

Hooked on science



Tammy Ma in the Jupiter Laser Facility.

Tammy Ma, a Lawrence Scholar and postdoctoral researcher at the Lab's National Ignition Facility, has received the 2010 Mechanical and Aerospace Engineering Award for Outstanding Graduate Student from the University of California, San Diego.

Her doctoral thesis was completed under the supervision of UCSD Professor Farhat Beg and NIF researcher Andrew MacPhee. Her research was closely connected to the fast ignition/high-energy density science at LLNL.

In a letter informing her of the award, Department Chair Sutanu Sarkar wrote, "Graduate students play a pivotal role in our department and at UCSD. You have been very productive in research related to electron transport and laser matter interactions, as evidenced through publication in reputed journals." In addition, she also received first-place standing for her talk at the UCSD All-Grads Symposium in 2008.

Ma says that she enjoyed her science classes while in high school and that's when she "got hooked. It seemed to fit my personality," she said about science.

LLNL applies and advances science and technology to help ensure national security and global stability. Through multi-disciplinary research and development, with particular expertise in high-energy-density physics, laser science, high-performance computing and science/engineering at the nanometer/subpicosecond scale, LLNL innovations improve security, meet energy and environmental needs and strengthen U.S. economic competitiveness. The Laboratory also partners with other research institutions, universities and industry to bring the full weight of the nation's science and technology community to bear on solving problems of national importance.

To send input to the Livermore Lab Report, send e-mail mailto:labreport@llnl.gov.

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